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In re Patent Application of:

Jong-haw CHO

Application No.: 10/648,328 Group Art Unit: 2838

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Filed: August 27, 2003 Examiner: Jeffrey L. Sterrett

For: HIGH VOLTAGE SUPPLY DEVICE FOR ELIMINATING A SURGE VOLTAGE (As Amended)

SUBMISSION OF ENGLISH TRANSLATION

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

Attached is the English translation of Korean Patent Application No. 2002-51607, filed August 29, 2002. It is respectfully requested that the attached English translation be made of record in the above-identified application.

If any further fees are required in connection with the filing of this English Translation, please charge same to our Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

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DECLARATION

I, Ginny Kang, a Korean citizen of #906, Sung-bo Apartment, Yeoksam-dong, Gangnam-gu, Seoul, Korea do hereby solemnly and sincerely declare as follows:

1. That I am well acquainted with the English and Korean languages.
2. That the following is a correct translation into English of Korean Patent Application No. 2002-51607 filed August 29, 2002, and I make the solemn declaration conscientiously believing the same to be true.

Seoul, March 9, 2006

Ginny Kang

Ginny Kang

KOREAN INTELLECTUAL PROPERTY OFFICE

This is to certify that the following application annexed hereto is a true copy from the records of the Korean Intellectual Property Office.

Application Number: Patent Application No. 2002-51607

Date of Application: August 29, 2002

Applicant(s): Samsung Electronics Co., Ltd.

Dated on September 23, 2002

COMMISSIONER

[DOCUMENT] Application for Patent

[RIGHT] Patent

[TO] The commissioner

[SUBMISSION DATE] August 29, 2002

[TITLE OF THE INVENTION-KOREAN] 고압전원장치

[TITLE OF THE INVENTION-ENGLISGH] High voltage generator

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[EXAMINATION REQUEST] YES

[PURPOSE] I, hereby, submit the present application for the Patent and request the examination of the present invention under the Article 42 and the Article 60 of the Patent Law.

Attorney Hong-sik JEONG (seal)

[Official Fee]

[Basic fee]	20	pages	₩	29,000
[Additional fee]	3	pages	₩	3,000
[Claiming Priority Right]	0	case	₩	0
[Filing Request For Examination]	10	claims	₩	429,000

[Total] ₩ 461,000

[Documents] 1. One copy of Abstract, Specification (& drawings)

[ABSTRACT OF THE DISCLOSURE]

[Abstract]

A high voltage supply device is disclosed. The high voltage supply device includes a power supply rectifying an externally inputted ac voltage and generating a first dc voltage and a second dc voltage, a controller generating a pulse signal having a predetermined duty ratio and a control signal having a first logic level when the first dc voltage is applied, a high voltage generator boosting the second dc voltage based on the pulse signal, and a power supply controller driven when the control signal is in the first logic level, and cutting off an application of the second dc voltage to the high voltage generator when the control signal is in a second logic level. Such a high voltage supply device, when used in electronic devices such as laser printers, facsimile machines and DC-DC converters requiring a high dc voltage, does not generate a surge voltage when the electronic devices are turned off, and, further, is not supplied therein with any dc voltage in the stand-by mode, to thereby reduce power consumption in the stand-by mode.

[The main figure]

FIG. 3

[Search term]

high voltage generator, transformer, multiple voltage rectifier, PWM

[SPECIFICATION]

[The title of the invention]

High voltage generator

[The brief description of the drawings]

FIG. 1 is a block diagram showing a conventional high voltage supply device,

FIG. 2 is a view showing an output voltage waveform of the high voltage supply device of FIG. 1 when the high voltage supply device is turned off,

FIG. 3 is a block diagram of a high voltage supply device according to a preferred aspect of the present invention,

FIG. 4 is a view of a high voltage generator of FIG. 3 according to another embodiment aspect of the present invention, and

FIG. 5 is a flow chart showing a high voltage control method according to the present invention.

Description of the reference numerals in the drawings

100: power supply	200: controller
300: high voltage generator	310: amplifier
320: comparator	330: voltage booster
340: rectifier	400: power supply controller
410: first switching part	420: second switching part

[Detailed description of the invention]

[Object of the invention]

[The field of the invention and the related art]

The present invention relates to a high voltage supply device, and more particularly to a high voltage supply device for substantially eliminating a surge voltage occurring upon

turning off electric power.

A high voltage supply device is commonly used for electronic devices, such as laser printers and facsimile machines, requiring a high dc voltage source. Such a high voltage supply device may convert a dc voltage into a high ac voltage, and regulate and convert the ac voltage into a high dc voltage. The high voltage supply generally has a transformer for converting a dc voltage into an ac voltage.

In the meantime, the high voltage supply device may generate an undesired surge voltage while converting dc voltages into ac voltages when using a transformer. An electronic device having such a high voltage supply device may induce a high surge voltage when power is turned off, by discharging a dc voltage applied to the transformer, and such a surge voltage may partially or totally damage the electronic device. In the case of a laser printer, a surge voltage, occurring at the time electric power applied to the printer is cutoff, may induce another surge voltage to be applied to an organic photo conductor drum, which may damage the drum. In addition, electric power applied to the high voltage supply device while in the stand-by mode is unnecessarily consumed.

FIG. 1 is a block diagram schematically showing a conventional high voltage supply device.

The high voltage supply device shown in FIG. 1 has a power supply 10, a controller 20, and a high voltage generator 30.

The power supply 10 rectifies an ac voltage externally applied, and generates dc voltages of, for example, 24V and 5V. The voltage of 24V may be used as an operation voltage for the high voltage generator 30, and the voltage of 5V may be used as an operation voltage of the controller 20.

The controller 20 outputs a pulse width modulation (PWM) signal having a

predetermined duty ratio according to a preset value.

The high voltage generator 30 generates ac voltages ranging from a few hundred volts to a few thousand volts by on and off switching operations by a PWM signal applied from the controller 20.

Preferably, the high voltage generator 30 includes a switching part 31, a transformer 32, and a rectifier 33.

The switching part 31 is repeatedly turned on and off by a PWM signal applied from the controller 20. For example, when the switching part 31 is turned off by a PWM signal from the controller 20, the voltage 24V cuts off a current path on an input side 32a of the transformer 32.

The transformer 32 induces a high ac voltage across output terminals 32b from the ac voltage of 24V turned on and off by the switching part 31. The number of wire windings of the output terminals 32b may be greater than the number of wire windings of the input terminals 32a in order to output a voltage higher than a voltage applied to the transformer 32.

The rectifier 33 rectifies and converts to a dc voltage, an ac voltage outputted from the output terminals 32b of the transformer 32. In general, the rectifier 33 uses a N-times multiple voltage rectification method to heighten a voltage outputted from the transformer 32.

At substantially the same time, the controller 20 sets the switching part 31 to be enabled in order to enhance the stability of signal inputs and outputs when an outputted PWM signal is a logic "low," generally referred to as an active low; one of methods frequently used in digital logic. Accordingly, when the dc voltage of 5V applied to the controller 20 is cutoff, a PWM signal outputted from the controller 20 becomes the logic "low" and, at this time, the switching part 31 may malfunction. Further, since the operation voltage of 5V of the controller 20 is very low compared to the operation voltage of 24V of the high voltage

generator 30, the voltage source of 24V has a potential level higher than the voltage source of 5V at the time the voltage source of 5V becomes a ground level when the high voltage supply device is turned off. For example, even when the operation voltage of the controller 20 of 5V is lowered to a value equal to, or less than, 2.5V, the dc voltage of 24V has a potential level of about 18V. Accordingly, when a PWM signal outputted from the controller 20 is a logic "low", the switching part 31 is turned on so that the input terminals 32a of the transformer 32 form a current path between the voltage potential of 18V and the ground terminal. In this case, a high ac voltage is induced across the output terminals 32b of the transformer 32, and rectified and outputted by the rectifier 33.

FIG 2 is a view showing an output voltage waveform of a high voltage supply device when the high voltage supply device of FIG 1 is turned off.

As shown in FIG 2, a dc voltage e.g., 18V exists across the input terminals 32a of the transformer 32 and the ground terminal at the time ①, when an ac voltage applied external to the power supply 10 is cut off, so that the voltage of 5V is lowered to a value equal to, or less, than 2.5V. At this time, since the voltage of 5V outputted from the power supply 10 drops to a value substantially equal to, or less than, 2.5V, the power supply 10 does not drive the controller 20 which operates at 5V, and a PWM signal outputted from the controller 20 becomes the logic "low". However, when the controller 20 is turned off at point ①, the dc voltage of 18V outputted from the power supply 10 has been applied to the input terminal of the transformer 32. Accordingly, when the potential level of the PWM signal outputted from the controller 20 becomes the logic "low", a voltage ⓐ as shown instantly exits between the input terminal 32a of the transformer 32 and the ground so that a high ac voltage e.g., surge voltage is induced across the output terminals 32b of the transformer 32.

As described above, a high dc voltage, applied to electronic devices such as laser

printers, facsimile machines, may damage parts of the electronic devices when the devices are in a power-off state.

[Technical object of the invention]

The present invention has been devised to solve the above problem, so it is a feature of the present invention to provide a high voltage supply device and a method for reducing surge voltage generations.

[Construction and operation of the invention]

According to an aspect of the present invention, a high voltage supply device includes a power supply rectifying an externally inputted ac voltage and generating a first and a second dc voltages, a controller generating a pulse signal having a predetermined duty ratio and a control signal having a first logic level when the first dc voltage is applied, a high voltage generator boosting the second dc voltage based on the pulse signal, and a power supply controller driven when the control signal is in a first logic level, and for cutting off an application of the second dc voltage to the high voltage generator when the control signal is in a second logic level.

Preferably, the amplifier includes a first transistor, the emitter of which is connected to a third dc voltage having a potential level between potential levels of the first dc voltage and the second dc voltage, and the base of which is applied with the control signal, and a first resistor connected between the collector of the first transistor and the ground potential.

The high voltage generator may include an amplifier amplifying the pulse signal from the controller, wherein the control signal is a pulse width modulation (PWM) signal, a comparator comparing the PWM signal outputted from the amplifier and a boosted voltage, a voltage booster boosting the second dc voltage based on switching operations according to an output of the comparator, and a rectifier rectifying an output of the voltage booster.

The comparator inputs an output of the amplifier through a positive input terminal thereof and input a fed-back boosted voltage through a negative input terminal thereof.

The voltage booster includes a second transistor, the emitter of which is grounded and the base of which is connected to an output of the comparator, and a transformer the input terminals of which are connected to a dc voltage applied through the power supply controller and the collector of the second transistor respectively.

The rectifier may be a N-times multiple voltage rectifier for boosting a potential level of a voltage outputted from the voltage booster.

The power supply controller includes a third transistor, the emitter of which inputs the second dc voltage and the collector of which outputs the second dc voltage, a second resistor connected between the emitter of the third transistor and the base of the third transistor, a third second resistor to one end of which is applied the control signal, a fourth transistor a base of which may be connected to the other end of the third resistor and an emitter which is grounded, a fourth resistor connected to the base and emitter of the fourth transistor, and a fifth resistor connected between the collector and base of the fourth transistor.

The power supply controller may be an NMOS transistor, a drain and a gate of which are inputted with the dc voltage, and a source of which becomes an output terminal.

According to another aspect of the present invention, a high voltage control method includes operations of rectifying an externally inputted ac voltage and generating a first dc voltage and a second dc voltage, generating a pulse signal having a preset duty ratio and a control signal having a first logic level based on the first dc voltage, boosting the second dc voltage based on the pulse signal, and cutting off the voltage boosting when the control signal is a second logic level.

Voltage boosting step includes amplifying the pulse signal, comparing the amplified

pulse signal and the boosted voltage, boosting the second dc voltage based on a result of the comparison, and rectifying the boosted voltage.

Hereinafter, the present invention will be described in detail with reference to the accompanying drawings.

FIG. 3 is a block diagram of a high voltage supply device according to an aspect of the present invention.

As shown in FIG. 3, a high voltage supply device may include a power supply 100, a controller 200, a high voltage generator 300, and a power supply controller 400.

The power supply 100 rectifies an externally applied ac voltage AC and generates dc voltages of e.g., 24V and 5V. High voltages ranging from a few hundred to a few thousand volts to be generated from the high voltage supply device are generated by the dc voltage of 24V. The voltage of 5V may be used as an operation voltage for operating the controller 200.

The controller 200 outputs a PWM signal having a predetermined duty ratio according to a preset value, and selectively generates a control signal pow_en having a logic "high" only when the high voltage supply device necessarily outputs a high voltage. In a case of a laser printer, for example, the controller 200 outputs the control signal pow_en having a logic "high" only when electrically charging the organic photo conductor drum with a high voltage. That is, the controller 200 is set to output the control signal pow_en only when a device such as a printer, facsimile machine with a high voltage supply device requires a high voltage. Such a setting may be obtained by implementing the controller 200 with a microcontroller (not shown). A memory (not shown) in the microcontroller may be programmed to output the control signal pow_en of logic "high" only when a high voltage is required.

The high voltage generator 300 responds to a PWM signal applied from the controller 200 and outputs voltages ranging from a few hundred to a few thousand volts.

The power supply controller 400 responds to the control signal pow_en outputted from the controller 200 when the control signal pow_en is in logic "high", and applies the dc voltage of 24V outputted from the power supply 100 to the high voltage generator 300. Accordingly, when the ac voltage labeled AC applied to the power supply 100 is turned off, the dc voltage of 24V is not applied to the high voltage generator 300 so that the high voltage generator 300 does not generate a surge voltage when the ac voltage AC is turned off.

The high voltage generator 300 has an amplifier 310, a comparator 320, a voltage booster 330, and a rectifier 340.

The amplifier 310 amplifies the PWM signal applied from the controller 200 to a predetermined potential level, for example, 18V.

The comparator 320 is provided with an operational amplifier having a positive (+) input terminal and a negative (-) input terminal. The operational amplifier may receive and compare a PWM signal outputted from the amplifier 310 through the positive input terminal and a fed-back part of a voltage outputted from the rectifier 340 through the negative input terminal. Accordingly, in a case where an output voltage of the rectifier 340 is higher than a predetermined level, an output of the operational amplifier 321 becomes the logic "low" and stops the operations of the voltage booster 330.

The voltage booster 330 turns on and off the input terminals 332a of a transformer 332 by the switching operations of a transistor 331, which is turned on and off according to a result of the comparison of the comparator 320, to thereby boost the dc voltage of example 24V applied from the power supply controller 400 to ac voltages ranging from a few hundred to a few thousand volts. The dc voltage of 24V across the input terminals of the transformer

voltage, for an example, a voltage higher than a five-times multiple voltage.

The power supply controller 400 has a first switching part 410 and a second switching part 420.

The first switching part 410 responds to the control signal pow_en outputted from the controller 200 driven when an output voltage of the power supply 100 becomes 5V, and lowers a node ⓓ to the ground potential. In here, the NPN-type transistor is used for a transistor 412, a resistor 411 for restraining electric current to be applied to the base of the transistor 412, a resistor 413 for biasing the transistor 412, and a resistor 414 for limiting an output current of the transistor 412.

The second switching part 420 forms a current path between a node ⓔ and node ⓕ when the node ⓓ becomes the ground potential by the first switching part 410. Therefore, when the control signal pow_en from the controller 200 becomes the logic "high", the dc voltage of, for example, 24V outputted from the power supply 100 is outputted from the collector of the transistor 421 and applied to the input terminals 332a of the transformer 332 of the voltage booster 330. At substantially the same time, a PWM signal outputted from the controller 200 keeps the transistor 331 of the voltage booster 300 turned off. At this time, the dc voltage of 24V is turned on and off at the input terminals 332a of the transformer 332 so that a high ac voltage is induced at the output terminals 332b of the transformer 332. When the ac voltage "AC" applied to the power supply 100 is turned off, the control signal pow_en outputted from the controller 200 driven with the dc voltage of 5V becomes the logic "low" so that the power supply controller 400 cuts off the current path between the node ⓔ and node ⓕ. That is, when the high voltage supply device is turned off, the dc voltage of example 24V is not applied to the input terminals 332a of the transformer 332 so that an

undesired surge voltage is not induced across the output terminals of the transformer 332.

FIG. 4 illustrates a power supply controller 400 of FIG. 3 according to another embodiment of the present invention.

As shown in FIG. 4, the power supply controller 400 of the high voltage supply device may be implemented with a MOS transistor 431. An NMOS-type transistor is used for the MOS transistor 431, and the gate of the MOS transistor 431 responds to the control signal pow_en outputted from the controller 200 to turn on and off the drain and source of the same. Accordingly, the high voltage generator 300 operates only with the control signal pow_en of logic "high" generated in the turn-on state of the controller 200, so that, when the ac voltage AC applied to the power supply 100 is turned off as in FIG. 3, substantially any surge voltage does not occur.

FIG. 5 is a flow chart showing a high voltage control method according to a preferred embodiment of the present invention.

First, an externally applied ac voltage AC may be rectified e.g., by a power supply 100 to generate predetermined dc voltages of 5V and 25V, for example (S100). The controller 200 generates a PWM signal, having a preset duty ratio with an input of the dc voltage of 5V, and outputs the control signal pow_en of logic "high" (S200). Next, the power supply controller 400 detects a logic level of the control signal pow_en (S300). The logic level is turned on when the logic level is "high", and turned off when the logic level is "low" (S400). Further, the high voltage generator 300 inputs the dc voltage of 24V when the power supply controller 400 is turned on, boosts the inputted voltage to predetermined voltages, for example, ranging from a few hundred to a few thousand volts, and does not operate when the power supply controller 400 is turned off (S500). A high voltage generator 300 generates a high ac voltage by switching operations turned on and off, based on

a PWM signal. Accordingly, the high voltage generator 300 has the transformer 332 capable of inducing a high ac voltage by the switching operations based on the PWM signal. That is, the high voltage generator 300 operates only with the control signal pow_en generated when an ac voltage AC is externally inputted to the power supply 100 and the dc voltage of 5V is applied to the controller 200, so that the high voltage generator 300 does not operate when the ac voltage is not applied to the power supply 100. Accordingly, when ac voltage from an external source is cutoff, surge voltage is not generated when a dc voltage applied to the transformer 332 of the high voltage generator 300 is discharged.

[Effect of the invention]

As described above, the present invention, when used in, for example, a laser printer and a facsimile machine requiring a high voltage supply device or an electronic device requiring a high dc voltage, does not generate a surge voltage when the power of such an electronic device is turned off. Further, the high voltage supply device is not supplied therein with any dc voltage while in the stand-by mode, to thereby reduce power consumption.

Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

[What is claimed is]

[Claim 1]

A high voltage supply device, comprising:

a power supply rectifying an externally inputted ac voltage and generating a first dc voltage and a second dc voltage;

a controller generating a pulse signal having a predetermined duty ratio and a control signal having a first logic level when the first dc voltage is applied;

a high voltage generator boosting the second dc voltage based on the pulse signal; and

a power supply controller driven when the control signal is in the first logic level, and cutting off an application of the second dc voltage to the high voltage generator when the control signal is in a second logic level.

[Claim 2]

The high voltage supply device of claim 1, wherein the amplifier includes:

a first transistor, the emitter of which is connected to a third dc voltage having a potential level between potential levels of the first dc voltage and the second dc voltage, and the base of which is applied with the control signal; and

a first resistor connected between the a collector of the first transistor and a ground potential.

[Claim 3]

The high voltage supply device of claim 1, wherein the high voltage generator includes:

an amplifier amplifying the pulse signal from the controller, wherein the control signal is a pulse width modulation (PWM) signal;

a comparator comparing the PWM signal outputted from the amplifier and a boosted voltage;

a voltage booster boosting the second dc voltage based on switching operations according to an output of the comparator; and

a rectifier rectifying and outputting an output of the voltage booster.

[Claim 4]

The high voltage supply device of claim 3, wherein the comparator inputs an output of the amplifier through a positive input terminal thereof and inputs a fed-back boosted voltage through a negative input terminal thereof.

[Claim 5]

The high voltage supply device of claim 3, wherein the voltage booster includes:

a second transistor, the emitter of which is grounded and the base of which is connected to an output of the comparator; and

a transformer, the input terminals of which are connected to a dc voltage applied through the power supply controller and the collector of the second transistor respectively.

[Claim 6]

The high voltage supply device of claim 3, wherein the rectifier is a N-times multiple voltage rectifier boosting a potential level of a voltage outputted from the voltage booster.

[Claim 7]

The high voltage supply device of claim 1, wherein the power supply controller includes:

a third transistor, an emitter of which inputs the second dc voltage and a collector of which outputs the second dc voltage;

a second resistor connected between the emitter of the third transistor and a base of the third transistor;

a third resistor, one end of which is applied with the control signal;

a fourth transistor, a base of which is connected to the other end of the third resistor and an emitter of which is grounded;

a fourth resistor connected to the base and the emitter of the fourth transistor; and

a fifth resistor connected between the collector of the fourth transistor and base of the third transistor.

[Claim 8]

The high voltage supply device of claim 1, wherein the power supply controller is an NMOS transistor, a drain and a gate of which are inputted with the dc voltage, and a source of which becomes an output terminal.

[Claim 9]

A high voltage control method, comprising steps of:

rectifying an externally inputted ac voltage and generating a first dc voltage and a second dc voltage;

generating a pulse signal having a preset duty ratio and a control signal having a first logic level based on the first dc voltage;

boosting the second dc voltage based on the pulse signal; and

cutting off the voltage boosting when the control signal is a second logic level.

[Claim 10]

The high voltage control method of claim 10, wherein the boosting includes: amplifying the pulse signal;

comparing the amplified pulse signal and the boosted voltage;

boosting the second dc voltage based on a result of the comparison; and

rectifying the boosted voltage.

FIG. 1

POWER SUPPLY

CONTROLLER

RECTIFIER

FIG. 3

POWER SUPPLY

CONTROLLER

FIG. 4

POWER SUPPLY

FIG. 5

START

AC VOLTAGE → DC VOLTAGE

GENERATE A PULSE SIGNAL BASED ON A PRESET DUTY RATIO

DETECT A CONTROL SIGNAL

CONTROL SIGNAL="H"?

BOOST THE DC VOLTAGE BASED ON THE PULSE SIGNAL

END